New Magellanic penguin Spheniscus magellanicus colony in a subantarctic island: good or bad news?

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Abstract

This paper provides data on a newly discovered colony for Magellanic penguin *Spheniscus magellanicus* in the southwest Atlantic Ocean. A new settlement for the species in the area was found while conducting southern rockhopper penguin *Eudyptes chrysocome* studies in the San Juan de Salvamento colony in Staten Island, Argentina. The newly established colony holds 88 breeding pairs. While the origin of the founders was not recognized, it is possible that individuals recently reached from the nearby Observatorio Island colony located ~ 20 km away. New colonies grant populations to expand and colonize new areas which holds promise in a climate change scenario. Nonetheless, this expansion might be in detriment of sibling species that already occupied the area.

Introduction

Gathering adequate information on the distribution and abundance of animal populations is important to identify threats and changes in conservation status of the species. Being more relevant for penguins as they are among the most threatened bird groups after albatrosses and petrels (Croxall et al. 2012, Trathan et al. 2015), apart from their key role in the marine food webs (Brooke 2004) and as sentinels of ocean health (Boersma 2008). Penguin population studies, including surveys, have been identified as top priority for research and conservation for this group (Boersma et al. 2020).

Penguins breed colonially and their populations are distributed in colonies (local patches) that are considered analogous to local populations in metapopulation dynamics (Bouzat et al. 2009, LaRue et al. 2013, Pozzi et al. 2015, Lois et al. 2020). Several species of penguins inhabit isolated and remote Antarctic and subantarctic islands. Thus, it is not outlandish that still many colonies remain unknown and unsurveyed (Fretwell et al. 2009, Borowicz et al. 2018).

The iconic Magellanic penguin *Spheniscus magellanicus*, is the most abundant seabird breeding in Argentina, with colonies located from about 55º south to 40º on islands and coast in the Atlantic Ocean including the Falkland/ Malvinas islands (Borboroglu et al. 2013). Magellanic penguins from northern populations colonized many locations on the mainland coast and expanded their breeding range northward (Schiavini et al. 2005, Borboroglu et al. 2013, Pozzi et al. 2015). The first systematic penguin survey within the Tierra del Fuego archipelago was carried out by Carrara (1952), but as he mentioned, weather conditions precluded to cover the entire region. In the 90´s several attempts to cover the whole Fuegian archipelago gave with Magellanic penguin numbers or locations at different localities including Isla Martillo along the Beagle, Año Nuevo islands, and Franklin Bay in Staten Island (Yorio et al. 1998).

Newly established colonies during the last decades in northern Patagonia increased at high rates, with the smallest new populations growing the fastest, while bigger and oldest colonies decreasing in numbers (Pozzi et al. 2015). Similar patterns were found for the Tierra del Fuego population, with smaller (newest?) colonies increasing during the last decades (Raya Rey et al. 2014) and bigger Observatorio island colony showing smaller numbers than previous records (Balza et al. 2022). Therefore, while current

field studies may be biased towards areas of known occupancy, the assessment of new colonies is relevant for the understanding of the status of the whole population.

Given the logistic challenges posed by the isolation and difficulties from land and coasts to reach certain areas in Staten Island it is not strange that some populations remain unknown. Thus, strong efforts have been made during the last decade for exploration and reveal the secrets of the region.

Methods

Study area

We were carried out research (11–17 Dec 2019) at the southern rockhopper colony from Cabo San Juan (54º 43´19.2´´S, 63º 48´40.4´´W) in Staten Island, Argentina (Schiavini 2000).

Estimation of active nest density

We first demarcated the colony patch by walking along its edge and using the track on the GPS (Garmin etrex 30). Then, we used the Point-centered Quarter Method to estimate the density of active nests in the area. We used four points systematically distributed along a central transect every 200 m, and measured the distance to the nearest active nest in four 90° quadrants for each point (Krebs, 1998). This technique is commonly used in forestry, and has also been used in other burrowing seabirds, in which an aerial assessment of active nests is not possible (Priddel et al. 2006).

Given the low number of breeding pairs estimated during a new field trip in the area, 18–19 December 2021, we counted all active nests (adult/s with chicks) within the entire colony area.

Results

While conducting research on the southern rockhopper penguin colony in San Juan Cape the characteristic vocalization of a Magellanic penguin was heeded by FZ and an individual detected entering a burrow nest, characteristic of the species in Tierra del Fuego colonies (Fig. 1).

We then proceed to walk throughout the entire area which measured 2.25 ha and it was approximately between 90–190 masl (Fig. 2).

The density of active nests was 21 nests /ha (95% CI: 11–31), yielding a total estimate of 76 nests (95% CI: 49–118) breeding pairs.

In December 2001 the entire survey of the colony accounted for 88 active nests.

Discussion

A new settlement for the Magellanic penguin species has been found in Tierra del Fuego, Argentina. The colony at San Juan de Salvamento, Staten Island embodied the fourth colony in the area after the known Franklin Bay (also in Staten Island), Observatorio and Goffré Islands colonies (Schiavini et al. 2005, Raya Rey et al. 2014, Balza et al. 2022). The southern rockhopper penguin colony at San Juan was reported in historical records at least from mid-1800 (Payro 1898). None of these chronicles mention Magellanic penguins nesting in this locality, though individuals from this species were documented swimming in nearby waters and nesting in Observatorio Island (Payro 1898). Since then, the colony was surveyed from the air and boat censuses for other species were performed at the colony entrance without noticing Magellanic penguins breeding (Schiavini 2000, Schiavini and Raya Rey 2001, Schiavini et al. 2004). Thus, we hypothesized that this newfound colony might have been founded in recent years. Population abundance was probably underestimated as the survey occurred during chick rearing instead of during the peak of laying, thus some individuals must have failed by that time and abandoned the nest area (Yorio et al. 1998).

The “seabird paradox” avowed that most seabirds exhibit high rates of philopatry despite their long-distance movements outside the breeding season (Milot et al. 2008). Although the expression of philopatry, quantified by Coulson (2016), is variable among taxa, and within species and influenced by environmental conditions. Nevertheless, evidence of colonization and range expansion have been documented for several penguin species (Frere et al. 1993, Ghys et al. 2008, Kush and Marin 2012, LaRue et al. 2013) including Magellanic penguins (Pozzi et al. 2015, Borboroglu et al. 2022). Magellanic penguins presented a northward expansion in the septentrional limit of the Atlantic range up to 40ºS over several decades (Boersma et al.1990, Carribero et al.1995, Bertellotti and Yorio 2005, Borboroglu et al. 2022). The small colony of Bahia Franklin together with this new colony, 58 km apart from each other, could represent an expansion toward other locations that mirror the situation in the north. Extra evidence is the higher growth rate of the Franklin Bay colony in comparison to the biggest ones (Raya Rey et al. 2014, Balza et al. 2022) as shown for newly settled northern colonies (Pozzi et al. 2015).

Two hypotheses have been offered as drivers to immigration to other breeding sites. The "Habitat Quality" hypothesis proposes that individuals choose to colonize other places when habitat (nest sites or foraging areas nearby) decrease in the natal breeding site. Then the “Individual Quality” hypothesis suggests that poor or less experienced competitors could increase their fitness by pioneering at new sites (Kildaw et al. 2005). Although, we still cannot confirm this colony probably was founded by individuals from the nearby Año Nuevo Islands colonies, Observatorio or Goffré, which by historical records seemed to be older (Schiavini et al. 2005, Balza et al. 2022). These colonies are only 20 km away from the new site and thus within the foraging range for the species during chick rearing (Rosciano et al. 2018), this precludes to lean toward the habitat quality hypothesis at least regarding foraging habitat. However, habitat quality in terms of nesting sites in Observatorio island could be deteriorated given bio-erosion by introduced rabbits (Balza et al. 2022) and probably Magellanic penguins themselves (Quiroga et al. 2020). Bio-erosion leaves a lower quality nesting area at least in terms of available free space for new burrows to dig (Quiroga et al. 2020). As a newly discovered colony we have no trend data, but the point-centered quarter

method was reliable to estimate the population size of colony, and it will represent a consistent method for the long-term monitoring of this population.

In northern Patagonia there was no evidence for the individual quality hypothesis given the higher breeding success and growth rate from younger colonies (Pozzi et al. 2015). Nevertheless, productivity alone cannot explain trends with dispersal having a key role (Pozzi et al. 2015).

Seabirds use the presence of conspecific to gather information on new settlement (Reed and Dobson 2993), and penguins are known to establish in places where other penguin species breed (Ghys et al. 2008). Southern rockhopper penguins whose known presence at this locality has been recorded could have been the cue for the first individuals to reach that place. Southern rockhopper and Magellanic penguins sharing nesting areas, although not intermingled, have been registered in other areas (Pütz et al. 2001, Schiavini et al. 2005). However, to our knowledge this is the first location where both species share the entrance to reach the nesting area, which is a rocky ledge typical for southern rockhopper penguins in comparison with the sandy or rocky beach normally occupied by nesting Magellanics. In fact, this would be the Magellanic penguin colony found at the highest altitude.

While detrimental at the individual level, migration and colonization leading to the establishment of colonies at new locations can provide long-term benefits such as gene flow, increased effective population size, and overall, enhanced viability of populations and species (Clobert et al. 2001) and is advantageous in a changing world (Kokko and López Sepulcre 2006). However, that which could represent an advantage for some species could be in detriment of other potential competitors such as these two sibling species. Following the climate change “winners and losers” concepts extended from Antarctic penguins (Forcada et al. 2006, Ainley et al. 2010, Clucas et al. 2014), we may speculate that in subantarctic islands the more generalist in terms of breeding and foraging range, habitats, and diet such as the Magellanic penguins (Boersma et al. 2013) could eventually displace a more restrictive species like southern rockhopper penguins (Pütz et al. 2013). In the Antarctic Peninsula generalist gentoo penguins as climate change winners in recent time expanded their range southward, while chinstrap and Adelie populations as losers of climate change are decreasing (Clucas et al. 2014). Rockhopper populations are suffering considerable declines and although some populations seem to be stable, mass-mortality events related to water temperature mediated food availability are occurring too frequently for populations to recover and thus are considered vulnerable (Birdlife International 2022). In this case Magellanic penguins overlapping ecological niches pose additional stress for this species that already face loss of habitat by invasive species (Pütz et al. 2013).

Penguins are seriously threatened with most species’ populations decreasing throughout their breeding range (Borboroglu and Boersma 2013). In this sense a new colony must be good news for conservation in times of a profound biodiversity loss crisis (Singh 2002). Nevertheless, we need to address implications for other species within the expansion range to have the bigger picture. Lastly, this finding highlights the importance of accounting for the connectivity among colonies and the need to consider metapopulation structure for conservation status of species (LaRue et al. 2013, Pozzi et al. 2015).

Declarations

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Author contribution statement

All author conducted field work. ARR and UB analyzed data. ARR wrote the manuscript. All authors read and approved the manuscript.

References

1. Ainley D, Russell J, Jenouvrier S, Woehler E, Lyver POB, Fraser WR, Kooyman GL (2010) Antarctic penguin response to habitat change as Earth's troposphere reaches 2 C above preindustrial levels. Ecological Monographs, 80(1), 49–66.
2. Balza U, Liljesthröm M, Pimper L, Franco-Navarro I, Cañas-Barrovecchio S, Zunino F, Domato I, Accardi S, Iturraspe R, Cano J &Raya Rey A (2022) Status of breeding birds at Observatorio and Goffré Islands, Argentina. Polar Biology, *45*(4), 667–673.
3. Bertellotti M, Yorio P (2005) Expansión hacia el norte en la distribución reproductiva del Pingüino de Magallanes. XI Reunión Argentina de Ornitología, *66*.
4. BirdLife International (2022) Species factsheet: *Eudyptes chrysocome*. Downloaded from http://www.birdlife.orgon11/07/2022.
5. Boersma PD (2008) Penguins as marine sentinels. Bioscience, 58(7), 597–607.
6. Boersma PD, Borboroglu PG, Gownaris N J, Bost CA, et al. (2020) Applying science to pressing conservation needs for penguins. Conservation Biology, 34(1), 103–112.
7. Boersma PD, Stokes DL, Yorio P M, Davis L, Darby J (1990) Reproductive variability and historical change of Magellanic Penguins (*Spheniscus magellanicus*) at Punta Tombo, Argentina. Penguin biology, *7*, 15–44.
8. Borboroglu PG, Boersma P D (Eds.) (2015) Penguins: natural history and conservation. University of Washington Press.
9. Borboroglu P, Pozzi L M, Parma A M, Dell'Arciprete P, Yorio P (2022) Population distribution shifts of Magellanic Penguins in northern Patagonia, Argentina: Implications for conservation and management strategies. Ocean & Coastal Management, *226*, 106259.

10. Borowicz A, McDowall P, Youngflesh C, Sayre-McCord T, Clucas G, Herman, R et al. (2018) Multi-modal survey of Adélie penguin mega-colonies reveals the Danger Islands as a seabird hotspot. Scientific reports, 8(1), 1–9.
11. Bouzat JL, Walker BG, Boersma P D (2009) Regional genetic structure in the Magellanic penguin (*Spheniscus magellanicus*) suggests metapopulation dynamics. The Auk, 126(2), 326–334.
12. Brooke M de L (2004) The food consumption of the world's seabirds. Proceedings of the Royal Society of London. Series B: Biological Sciences, 271(suppl_4), S246-S248.
13. Carrara I S (1952) Lobos marinos, pingüinos y guaneras de las costas del litoral marítimo e islas adyacentes de la República Argentina. In: Lobos marinos, pingüinos y guaneras de las costas del litoral marítimo e Islas adyacentes de la República Argentina pp. 198–198.
14. Carribero A, Perez D, Yorio P (1995) Actualización del estado poblacional del pingüino patagónico *Spheniscus magellanicus* en Península Valdés, Chubut, Argentina. El Hornero, 14(01y02), 033–037.
15. Clobert J, Danchin E, Dhondt AA, Nichols J (2001) *Dispersal*.
16. Clucas GV, Dunn M J, Dyke G, Emslie, SD, Levy H, et al. (2014) A reversal of fortunes: climate change ‘winners’ and ‘losers’ in Antarctic Peninsula penguins. Scientific reports, 4(1), 1–7.
17. Coulson JC (2016) A review of philopatry in seabirds and comparisons with other waterbird species. Waterbirds, 39(3), 229–240.
18. Croxall JP, Butchart SH, Lascelles BEN, Stattersfield AJ, Sullivan BN, Symes A, Taylor PHIL (2012) Seabird conservation status, threats and priority actions: a global assessment. Bird Conservation International, 22(1), 1–34.
19. Forcada J, Trathan PN, Reid K, Murphy EJ, Croxall JP (2006) Contrasting population changes in sympatric penguin species in association with climate warming. Global Change Biology, *12*(3), 411–423.
20. Frere E, Gandini M, Gandini P A, Holik T M, Lichtschein V, Oliva Day M (1993) Variación anual en el número de adultos reproductivos en una nueva colonia de Pingüino Penacho Amarillo *Eudyptes crestatus* (Spheniscidae) en Isla Pingüino (Santa Cruz, Argentina). El Hornero, 13(04), 293–294.
21. Fretwell PT, Trathan PN (2009) Penguins from space: faecal stains reveal the location of emperor penguin colonies. Global ecology and biogeography, 18(5), 543–552.
22. Ghys MI, Raya Rey A, Schiavini A (2008) Population trend and breeding biology of gentoo penguin in Martillo Island, Tierra Del Fuego, Argentina. Waterbirds, 31(4), 625–631.
23. Kildaw SD, Irons DB, Nysewander DR, Buck CL (2005) Formation and growth of new seabird colonies: the significance of habitat quality. Marine Ornithology, *33*, 49–58.
24. Kokko H, López-Sepulcre A (2007) The ecogenetic link between demography and evolution: can we bridge the gap between theory and data? Ecology Letters, 10(9), 773–782.
25. LaRue MA, Ainley DG, Swanson M, Dugger KM, Lyver POB, Barton K, Ballard G (2013) Climate change winners: receding ice fields facilitate colony expansion and altered dynamics in an Adélie penguin metapopulation. PLoS One, 8(4), e60568.

26. Milot E, Weimerskirch H, Bernatchez L (2008) The seabird paradox: dispersal, genetic structure and population dynamics in a highly mobile, but philopatric albatross species. Molecular Ecology, 17(7), 1658–1673.
27. Payró RJ (1898) La Australia Argentina: excursión periodistica a las costas patagónicas, Tierra del Fuego é Isla de los Estados; con una carta-prólogo del general Bartolmé Mitre. La Nación.
28. Pozzi LM, Borboroglu PG, Boersma PD, Pascual MA (2015) Population regulation in Magellanic penguins: what determines changes in colony size? PLoS One, 10(3), e0119002.
29. Pütz K, Ingham RJ, Smith JG, Croxall JP (2001) Population trends, breeding success and diet composition of gentoo Pygoscelis papua, magellanic *Spheniscus magellanicus* and rockhopper Eudyptes chrysocome penguins in the Falkland Islands. A review. Polar Biology, 24(11), 793–807.
30. Pütz K, Raya Rey A, Otley H (2015) Southern rockhopper penguin. In Borboroglu, PG, Boersma PD (Eds.). Penguins–natural history and conservation. University of Washington Press, Seattle, WA, 113–129.
31. Quiroga DRA, Coronato A, Scioscia G, Raya Rey A, Schiavini A, Santos-González J, et al. (2020) Erosive features caused by a Magellanic penguin (Spheniscus *magellanicus*) colony on Martillo Island, Beagle Channel, Argentina. Cuadernos de Investigación Geográfica, 46(2), 477–496.
32. Raya Rey A, Rosciano N, Liljesthröm M, Sáenz Samaniego R, Schiavini A (2014) Species-specific population trends detected for penguins, gulls and cormorants over 20 years in sub-Antarctic Fuegian Archipelago. Polar Biology, 37(9), 1343–1360.
33. Reed JM, Dobson AP (1993) Behavioural constraints and conservation biology: conspecific attraction and recruitment. Trends in Ecology & Evolution, 8(7), 253–256.
34. Rosciano NG, Pütz K, Polito MJ, Raya Rey A (2018) Foraging behaviour of Magellanic Penguins during the early chick-rearing period at Isla de los Estados, Argentina. Ibis, 160(2), 327–341.
35. Schiavini A (2000) Staten Island, Tierra del Fuego: the largest breeding ground for Southern rockhopper penguins? Waterbirds, 286–291.
36. Schiavini AC, Crespo EA, Szapkievich V (2004). Status of the population of South American sea lion (*Otaria flavescens* Shaw, 1800) in southern Argentina. Mammalian Biology, *69*(2), 108–118.
37. Schiavini A, Yorio P, Gandini P, Raya Rey A, Dee Boersma P (2005) Los pingüinos de las costas argentinas: estado poblacional y conservación. El hornero, 20(1), 5–23.
38. Schiavini AC, Raya Rey A (2001) Aves y Mamíferos en Tierra del Fuego. Estado de situación, interacción con actividades humanas y recomendaciones para su manejo. Informe preparado bajo contrato con el Proyecto Consolidación e Implementación del Plan de Manejo de la Zona Costera Patagónica. Proyecto ARG/97/G31 GEF/ PNUD/MREIC
39. Singh JS (2002) The biodiversity crisis: a multifaceted review. Current Science, 638–647.
40. Trathan PN, García-Borboroglu P, Boersma D, Bost CA, Crawford RJ, Crossin GT, et al. (2015) Pollution, habitat loss, fishing, and climate change as critical threats to penguins. Conservation Biology, 29(1), 31–41.

41. Yorio P, Frere E, Gandini P, Harris G (1998) *Atlas de la distribución reproductiva de aves marinas en el litoral Patagónico Argentino* (pp. 75–117). Puerto Madryn, Argentina: Fundación Patagonia Natural.

Figures

Figure 1

Magellanic penguin nesting at San Juan Cape.

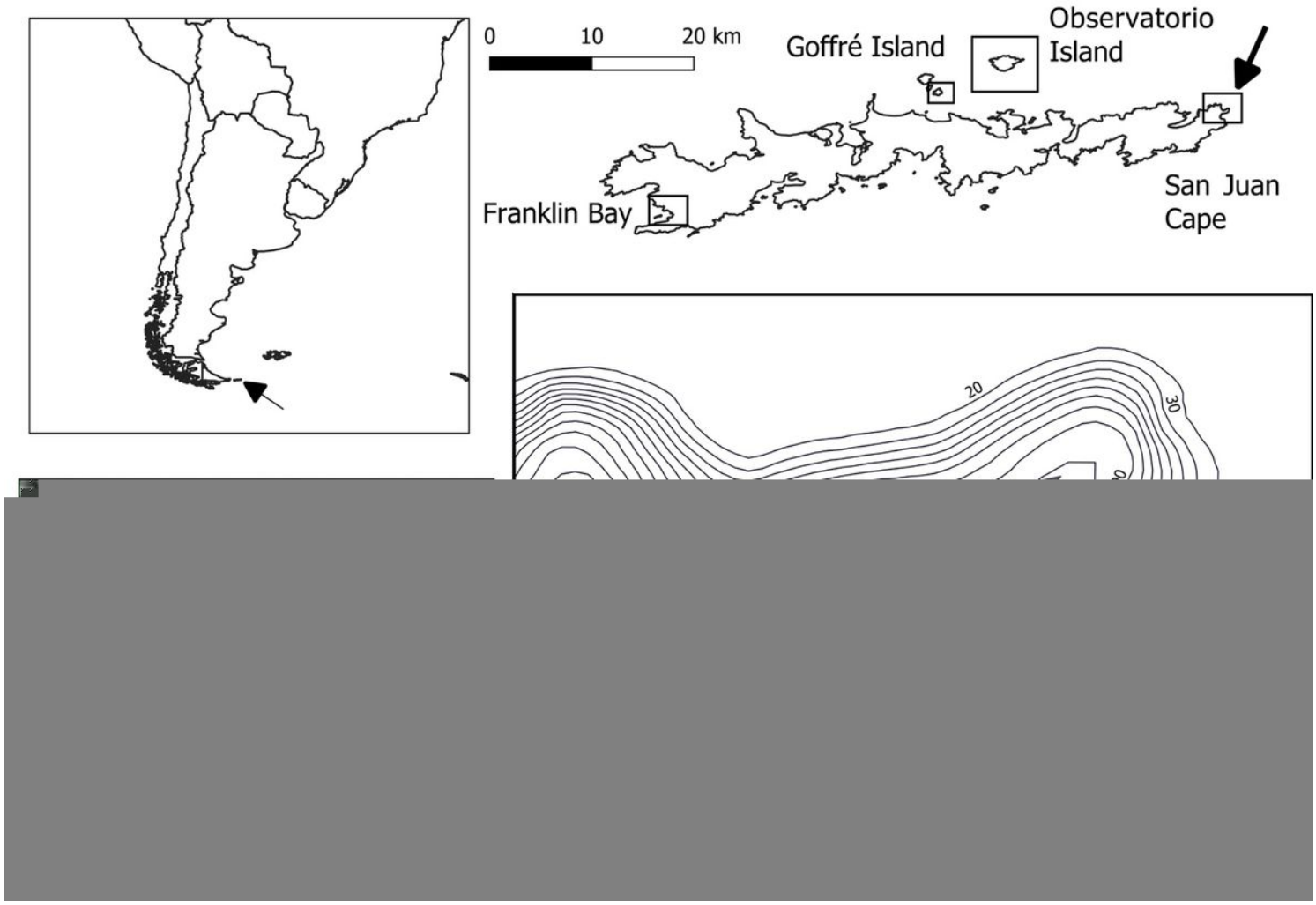

Figure 2

Map of the study area. On the top-right, the four Magellanic penguin colonies known in Staten and Año Nuevo Islands: Franklin Bay, Observatorio Island, Goffré Island and the arrow shows the newly described colony of San Juan Cape. Below, the shaded area represents the colony area, and the lines represents 10-m altitude landmarks.